

# Problems

30.P.4

$$1.0 \times 10^{16} e$$

Silver wire

in 320 ns

$$V_d = 8.0 \times 10^{-4} \text{ m/s}$$

Diameter of wire

$$N_e = i_e \Delta t$$

$$i_e = \frac{N_e}{\Delta t}$$

$$N_e = 1.0 \times 10^{16} e$$

$$n_e = 5.8 \times 10^{28} \text{ m}^{-3}$$

$$\Delta t = 320 \times 10^{-9} \text{ s}$$

$$V_d = 8.0 \times 10^{-4} \text{ m/s}$$

$$i_e = n_e A V_d$$

$$\frac{N_e}{\Delta t} = n_e A V_d$$

$$A = \frac{N_e}{n_e V_d \Delta t}$$

$$A = 6.735 \times 10^{-7} \text{ m}^2$$

$$\sqrt{\frac{A}{\pi}} = r$$

$$D = 2r$$

$$0.000463 \text{ m} = r$$

$$D = 9.3 \times 10^{-4} \text{ m}$$

$$D = 0.93 \text{ mm}$$

30.P.6

$$D = 1.0 \text{ mm}$$

Gold wire

$$L = 10 \text{ cm}$$

a.  $N_e = n_e V$   
 $n_e = 59 \times 10^{28}$   
 $V = 7.85 \times 10^{-8} \text{ m}^3$

$V = (\pi r^2) L$   
 $= (\pi (0.5 \times 10^{-3} \text{ m})^2) (10 \times 10^{-2} \text{ m})$   
 $V = 7.85 \times 10^{-8} \text{ m}^3$

$$N_e = 4.63 \times 10^{21} \text{ electrons}$$

b.  $N_e = i_e \Delta t$   $Q = I \Delta t$   
 $i_e = n_e A V_d$   $I = e i_e$

$$Q = I \Delta t$$

$$Q = e i_e \Delta t$$

$$Q = e n_e A V_d \Delta t \quad V_d \Delta t = L$$

$$\frac{Q}{e n_e A} = V_d \Delta t$$

$$L = \frac{Q}{e n_e A}$$

$$L = 4.31 \times 10^{-12} \text{ m}$$

$$L = 4.31 \times 10^{-12} \text{ m}$$

30.P.8

$$\vec{E} = 2.0 \times 10^3 \text{ V/m}$$

$$i_e = 3.0 \times 10^{17} \text{ e/s} \quad \text{a.) } V_d? \quad 7.43 \times 10^{-6} \text{ m/s}$$

$$\text{Aluminum wire} \quad \text{b.) } \gamma? \quad 2.11 \times 10^{14} \text{ s}$$

$$r = 0.5 \times 10^{-3} \text{ m}$$

a.)  $i_e = n_e A V_d$   $A = \pi (0.5 \times 10^{-3} \text{ m})^2$   
 $n_e = 6.0 \times 10^{28} \text{ m}^{-3}$

$$V_d = \frac{i_e}{n_e A}$$

$$i_e = 3.0 \times 10^{17} \text{ e/s}$$

$$V_d = 7.43 \times 10^{-6} \text{ m/s}$$

b.)  $V_d = \frac{e \gamma E}{m}$   $V_d = 7.43 \times 10^{-6} \text{ m/s}$   
 $m = 9.11 \times 10^{-31} \text{ kg}$

$$\gamma = \frac{V_d m}{E e}$$

$$E = 2.0 \times 10^3 \text{ V/m}$$

$$e = 1.602 \times 10^{-19} \text{ C}$$

$$\gamma = 2.11 \times 10^{14} \text{ s}$$

P: 4,6,8

Ca: 3

Ch: 30

30.P.4

$$N_e = 1.0 \times 10^6 e$$

$$\Delta t = 320 \times 10^6 s$$

$$N_e = i_e \Delta t$$

$$i_e =$$

30.C.3

This is because the wire is already  
stuffed full with electrons.